9-1-2011

The Impact of Frailty on Health Related Quality of Life in Heart Failure

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Recommended Citation

Buck, H. G., & Riegel, B. (2011). The Impact of Frailty on Health Related Quality of Life in Heart Failure. *European Journal of Cardiovascular Nursing, 10* (3), 159-166. http://dx.doi.org/10.1016/j.ejcnurse.2010.06.001

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Abstract

Background/Aims: Most heart failure (HF) hospital discharges involve people > 65 years, many frail. The purpose of this study was to determine if frailty explains variability in health related quality of life (HRQOL) in older adults with HF over and above known correlates.

Methods: A frailty index score was developed by weighting age, number of comorbid conditions, and symptom severity. A multivariate hierarchical regression analysis of known predictors of HRQOLgender, income, ethnicity, health perception, NYHA class — were entered first and then the frailty index was entered and regressed on HRQOL in 2 unique samples.

Results: When known predictors were tested on a sample they explained 11% (p 0.14) of the variance in HRQOL; when the frailty index score was added 24% (p 0.001) was explained. When the index was validated in a second sample, known predictors explained 15% (p 0.04) of the variance; with the frailty index score 40% (p 0.000) was explained.

Conclusion: Frailty explains significant amounts of variance in HRQOL in HF. Treating comorbid conditions and controlling symptoms may improve HRQOL in HF patients. These findings support the need for further research into the impact of frailty on HRQOL in HF patients.

Keywords

index score, regression, predictors of HRQOL, frailty

Disciplines

Analytical, Diagnostic and Therapeutic Techniques and Equipment | Cardiology | Cardiovascular Diseases | Circulatory and Respiratory Physiology | Medical Humanities | Medicine and Health Sciences | Nursing | Preventive Medicine

Title: The Impact of Frailty on Health Related Quality of Life in Heart Failure

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Introduction

Globally, cardiovascular disease (CVD) is the number one cause of morbidity and mortality in both developed and developing countries[1]. In the United States[2] (US) and most European countries[1] CVD is also a disease of aging. Almost two thirds of the six million people discharged from the hospital in the US with CVD are 65 years of age or older[2]. In particular, 73% of those discharged with the diagnosis of heart failure (HF) were over the age of 65 [2]. The development of a chronic syndrome, like HF, can precipitate concurrent frailty[3]. Frailty, defined as a state of risk or vulnerability brought about by co-occurring, multiple system deterioration resulting in adverse outcomes, is highly prevalent in the older adult population [3-6]. Because multiple systems are compromised and regulating one system may affect another, frail, older adults with HF are at risk for increased hospitalizations[7]. A further negative outcome common is poor health related quality of life (HRQOL), an issue that is already particularly problematic for older adults with HF [8]. *Frail older adults with HF are frequently hospitalized increasing their risk for additional deficits.*

Each one of these older adults hospitalized with HF was cared for by a nurse, many of whom specialize in cardiovascular nursing. Cardiovascular nurses also provide expert care to HF patients in outpatient settings. But are these nurses equally prepared to recognize frailty and care for older adults? While frailty has been studied and discussed extensively in the geriatric literature, reference to frailty is limited in the cardiovascular literature [3, 5, 6]. Further exploration is needed to determine whether there is a relationship between frailty and HRQOL, individually and in relation to both morbidity and mortality [4, 9, 10]. Therefore, the purpose of this study was to explore the relationship between frailty and HRQOL in older HF patients.

Frailty in Heart Failure

Frailty is currently understood in one of two ways. One way defines frailty as a clinical syndrome based on selected physical indicators resulting in vulnerability [4]. A second way defines frailty as a multi-factorial state of deficits accumulated over the life course [3]. Fried and colleagues [4] developed a phenotype of frailty using data from the Cardiovascular Health Study. Frailty, as a clinical syndrome, was said to be present if a person presented with three or more of the following symptoms: an unintentional weight loss of 10 lbs in the past year, weakness measured via grip strength, fatigue, decreased activity, or slowed walking speed. In cardiovascular samples, frailty is most commonly found in those with multiple comorbid conditions[11]. About half of a community dwelling sample of over 5,000 older persons met the criteria for frail (3 or more indicators) or near frail (1 or 2 indicators). Frailty was associated most strongly with age and a history of HF (odds ratio 7.51, 95% confidence interval 4.66 – 12.12) [12]. In another study of 670 community dwelling women, cardiovascular disease (CVD) increased the risk of frailty in those with mild anemia. A significant multiplicative interaction was found between hemoglobin level and CVD status with respect to the risk of frailty when controlling for age and other covariates. Chaves and colleagues [13] theorized that CVD diminished the effectiveness of compensatory responses to anemia resulting in increased vulnerability.

Frailty is associated with disability but differentiated by its biologic antecedents of decreased physiologic reserve and resistance to stressors, while disability is understood to involve an inability to perform certain activities. Fried and colleagues [4] found only a modest concordance between frailty and disability but that there was a significant stepwise increase in disability as frailty increased. In persons with HF, frailty has been found to predict falls, disability, hospitalization, and death [4, 9].

Health Related Quality of Life in Heart Failure

HRQOL is a subjective, multidimensional construct that links physical, psychological, and social well-being with the ability to carry out the activities of daily living [14]. In HF, subjective variables like symptoms, functional status, anxiety and health perception are consistently associated with HRQOL with more symptoms, poorer functional status, greater anxiety scores and poor health perception associated with poorer HRQOL [15-19]. More objective indices like ejection fraction, B-type natriuretic peptide (BNP), and jugular venous distention have not been found to have a direct effect on HRQOL [17, 18].

HRQOL impacts morbidity, mortality, and treatment choices for patients. In a Spanish sample, worsening HRQOL predicted hospital readmission and mortality for HF patients at a frequency comparable to other well known predictors such as a history of diabetes or treatment with an angiotensin converting enzyme inhibitor [10]. Patients with poorer HRQOL are more willing to trade survival time and take risks in treatment choices than those with better HRQOL [20, 21].

From the literature it can be theorized that there is a relationship between frailty and HRQOL. The relationship between frailty and disability[4] in addition to the relationship between functional status and HRQOL[8] supports the hypothesis that there would be a relationship between frailty and HRQOL. However, no study was found that examined this hypothesis. Therefore, in this secondary analysis we explored this relationship between frailty and HRQOL in persons with HF after accounting for known determinants of HRQOL.

Building on our previous work which was tested in another end stage disease population, we continue to explore whether a framework in which quality of life is the primary outcome is applicable in other disease populations[22]. In this framework variability in HRQOL is explained by both fixed and modifiable dimensions of the domains of the patient's lived experience. The domains are physiological, psychological, social/cultural, and spiritual/existential. The measured indicators for the fixed dimensions need to be accounted for but the indicators for the modifiable dimensions, depending on whether they directly or inversely impact HRQOL, need to be either supported or ameliorated. For this study frailty is conceptualized as including indicators for both fixed and modifiable dimensions for the physiological domain – the patient's age and number of comorbid conditions are fixed while symptom severity is modifiable and therefore amenable to interventions focused on improving quality of life.

Methods

In this secondary analysis frailty was conceptualized as a construct measured using the person's age at time of enrollment into the study, number of comorbid conditions, and a total severity score for three symptoms prevalent in this population – fatigue, dyspnea on exertion, and chest pain. Age was obtained by self-report. Comorbid conditions were measured using the 17-item Charlson Comorbidity Index, which generates a total possible score ranging from 0-30. A higher score indicates a higher level of comorbid disease [23]. The symptom scale asked the person to rank each symptom (fatigue, dyspnea on exertion, chest pain) on a 1-10 scale with the anchors, 1 = very mild and 10 = worst imaginable. Zero was entered if the symptom was not reported.

The index was formed by weighting these three indicators (age, comorbidity, symptoms) using weights derived from an analysis performed in a benchmark sample of 130 older adults with HF who had been accrued for a previous intervention study[24]. The individual items were regressed on the total Minnesota Living with Heart Failure Questionnaire (MLHFQ) score and then the unstandardized coefficients and the constant from that regression were used to derive the weights for the new frailty index. Potential contamination between the MLHFQ score and the three indicators was assessed by examining collinearity statistics. Residual statistics and influence were also analyzed. The regression equation was Predicted MLHFQ total score = (66 + (age x -0. 597) + (symptom severity x 1.426) + (comorbidity score x 1.38)). The index was then confirmed in a second sample which was split into two unique groups to test and validate the stability of the findings. Known determinants of HRQOL were accounted for in all analyses.

Sample

The benchmark sample participants were accrued from two Southern California hospitals [24]. The test sample was from five hospitals in the same area [25]. The recruitment of the participants and procedures have been described in detail elsewhere, but in brief, HF patients were enrolled during hospitalization, half received a disease management intervention, and all were followed for 6 months[24, 25]. The test sample was divided in half with one half used to test the index (Test sample one) and the second half used to validate the stability of the index (Test sample two). Both the benchmark and test samples were hospitalized with a primary diagnosis of HF at the time of enrollment and able to speak English or Spanish. Patients with an obvious cognitive impairment, an untreated psychiatric illness, or a terminal disease, were excluded as were those on renal dialysis and those being discharged to a long term care facility. Only baseline data collected at enrollment were used to develop and test the frailty index. This investigation conformed with the principles outlined in the Declaration of Helsinki[26].

Measurement

HRQOL was measured by the total score on the MLHFQ [27]. The MLHFQ, used widely in HF research, asks the person to rate the impact (0 = no impact to 5 = most severe impact) of their condition or its treatment on various aspects of daily life. The items are additive, yielding a total score of 0-105, with a lower score reflecting less impact or better HRQOL. For this study the Cronbach's alpha for the two test samples was 0.92.

Demographics (i.e. gender, ethnicity, marital status, education level, work status, and income) were obtained by self-report. Health perception was measured by a one item question asking the person to rate his or her health (1 = much worse to 5 = much better) as compared with a year ago.

Data Analysis

Multivariate hierarchical regression modeling was conducted using SPSS version 15.0 [28]. Predictors of HRQOL were identified from the literature. Two model blocks (1st block: NYHA class, ethnicity, income, health perception, and gender; 2nd block: new frailty index) were tested with HRQOL as the dependent variable on Test sample one and then validated with Test sample two. A *p* value of less than 0.05 was accepted as statistically significant. Collinearity statistics and residual statistics were scrutinized.

Results

Characteristics of the Sample

In the benchmark sample used to develop the frailty index, a total of 130 older adults, median age 72 years, 98% NYHA III or IV HF were included. Test sample one included a total of 97 unique persons, median age 76 years, 87% NYHA class III or IV HF. Test sample two included 75 additional persons, median age 72 years, 92% NYHA class III or IV HF. In the test sample participants were likely to be female, married, white, retired, finished high school, and lower income. Differences between the benchmark sample and the test sample were analyzed using chi square with a Bonferroni adjustment to control for Type I errors, a *p* of 0.007 was necessary for significance. Individuals in the benchmark sample were more likely than the two test samples to be Hispanic, NYHA Class IV, with less than a 7^{th} grade education, and make under $10,000 (US) a year in income. See Tables 1 and 2 for additional demographic information and the means (standard deviations) on the frailty index for all samples.

Effect of Known Predictors and Frailty Index on HRQOL

For the benchmark sample, the zero-order and partial correlations for age show that when symptoms (fatigue, dyspnea, and chest pain) and number of comorbid conditions are controlled, age has less influence *on MLHFQ total* (Table 3). *Similar findings result for symptoms when controlling for age and comorbidity as well as for comorbidity when age and symptoms are controlled.* The semi-partial correlations show that when assessing the unique amount of variance accounted for by age, symptoms, or comorbidity on MLHFQ total, age and symptoms continue to show a moderate amount of correlation. Due to this moderate correlation, collinearity statistics were examined before the analysis continued. Tolerance and its inverse (variance inflation factor) are within accepted limits (Table 3). The same analysis was conducted on Test sample one and Test sample two. Inspection of the residual statistical output for the benchmark sample showed that while at least one prediction was more than two standard deviations below the mean residual(-2.45) there was no undue influence exerted with maximum leverage of 0.09. In Test sample one the standardized residual was -2.18 (max leverage 0.54) and for Test sample two the standardized residual was -2.36 (max leverage 0.52).

Using multivariate hierarchical regression, known predictors of HRQOL - NYHA class, ethnicity, income, health perception, and gender were regressed upon the total MLHFQ score in the first block. The frailty index was then entered in the second block. In Test sample one and two the frailty index significantly increased the amount of variability predicted for HRQOL (Table 4). The standardized β show that when the other predictors are held constant that MLHFQ total score will, on average, increase 0.37 SD (Test sample one) and 0.54 SD (Test sample two) when the frailty index increases one standard deviation. A higher MLHFQ total score denotes lower HRQOL for the patient.

Discussion

In this study we examined the relationship of frailty and HRQOL in older adults with HF. We found that when frailty was measured as a composite of age, number of comorbid conditions, and symptom status a significant amount of variability in HRQOL was explained over and above know determinants of HRQOL. While 627 publications were found citing Fried and colleagues [4] seminal work on developing a phenotype of frailty in the geriatric population, this is the first study of HRQOL and frailty in community dwelling older adults with HF. This study supports the importance of nurses being aware of and assessing the risk for frailty in older adult with HF but it also provides easily obtained indicators for assessing for the presence of frailty in their patients. When these frailty indicators are present the nurse can then implement evidence based best practice protocols to address the risk to decreased quality of life that they represent. This frailty index combines both current conceptualizations of frailty (clinical syndrome, multifactorial state) into a clinically useful measurement.

Age and frailty are linked but distinct phenomena [3, 6]. Heterogeneity in the older adult population may account for the differences between age and frailty. While older adults with HF report poorer HRQOL than age matched healthy groups [8] it is less clear whether age alone effects HRQOL in HF. As this study showed, when number of comorbid conditions and symptoms were held constant the influence of age decreased. Two recent studies in HF populations found that while not the strongest predictor, age, did predict HRQOL when analyzed with other independent variables – with older patients reporting better HRQOL[29, 30]. This finding is supported in other disease populations, such as oncology, where older adults generally report higher quality of life and less symptom distress even when they have greater numbers of comorbid diseases and more symptom burden than younger persons at the same disease stage [31, 32]. The weighting of age in this index shows that it is less explanatory of frailty than the other two indicators – number of comorbid conditions and symptom severity.

Conceptually, comorbidity has been suggested as a mediator between physiological processes and clinical outcomes [33]. HF patients are also known to be more likely to have diabetes[11], renal failure[34], and depression[35] in addition to other comorbidities[36]. The number of comorbid conditions is known to be related to frailty [4, 37]. Perhaps the metabolic stress placed on the body by multiple disease processes in the presence of diminishing metabolic reserves may potentiate the osteopenia and sarcopenia noted as hallmarks of frailty[38]. In this study the number of comorbid conditions contributes more to the frailty index than age but not as much as symptom severity.

It has been suggested that chronic symptoms are seen by the older adult as normal in aging [32]. However, in this study we showed that rating higher severity on the three symptoms found most frequently in HF – fatigue, dyspnea on exertion, and chest pain – contribute to frailty, perhaps by limiting activity, which may set up a negative feedback system whereby the decreased activity leads to greater risk for increased frailty and decreased HRQOL. Morley, Perry, and Miller [38] have developed a model to explain the etiology of frailty in older adults. They proposed that pain is one precursor that leads to inactivity, then sarcopenia, and finally, frailty. Additional etiologic factors suggested are malnutrition, atherosclerosis, cognitive impairment and social factors[38]. The relationships between age, symptoms, and HRQOL found in this study is supported by previous work conducted in adults with HF by Heo and colleagues [29].

While there is extensive literature on quality of life in the oncology and geriatric populations, in comparison, there is a paucity of work exploring the predictors of HRQOL in cardiac patients. Prior to 2000, HRQOL was a rare primary endpoint in HF clinical trial[14, 39]. In the intervening years, those studies that have assessed HRQOL found poorer HRQOL to be directly or indirectly associated with NYHA functional class, depression, number of medications, serum creatinine, and lower ejection fraction [10, 15, 17, 40]. Together, these isolated predictors could be thought of as indicators of frailty, a conceptual leap that would move the field forward.

Bekelman and colleagues [16], in a NYHA class II population, found 32% of the variance in HRQOL was explained by the number of symptoms. Our study supports the increasing importance of the symptom experience as the individual declines by using a mostly NYHA class III and IV population, while also accounting for two other well known predictors of HRQOL – age and number of comorbid conditions. Bekelman used the Memorial Symptom Assessment Scale –short form (MSAS) which assesses the presence, severity, and distress caused by 25 symptoms common in patients. It is interesting to note that while the version of the MSAS used by these researchers was not developed for cardiac patients, the top three symptoms reported in Bekelman's study were shortness of breath, lack of energy, and pain (area not specified). Our symptom severity score included fatigue and shortness of breath while assessing for specific cardiac (chest) pain.

Heo and colleagues found that gender, work status, affective state, and symptom status all predicted HRQOL [8, 18, 41]. Furthermore, subjective variables – health perception and symptom status, were stronger predictors of HRQOL than more objective variables like disease etiology and number of comorbidities. A model inclusive of a single item health perception question, symptom status, and age explained 29% of the variance in the total MLHFQ [18]. The difference in the findings between our study and Heo and colleagues' may be related to the developed frailty index. Age, symptom severity, and number of comorbid conditions are weighted differently to reflect their known influence on HRQOL.

Quality of life has been described as reflecting the totality of the individual's experiences and perceptions over time but also to depend on the time at which it is measured [42]. As to whether subjective quality of life is a state (situationally determined) or trait (dispositionally determined) measure needs further exploration. Cummins [43] suggests that each individual has a normative level of subjective well-being which is generally positive and insensitive to gradual and low levels of degradation. However, he suggests that current atheoretical conceptualizations and poor measurement of quality of life hinder the advancement of the science. Cummins goes on to recommend that further work in the area include: 1) agreement in quality of life measurement as to which variables are indicator and which are causal, 2) organization of indicator variables hierarchically from general to specific, and 3) development of instruments based on this hierarchy. Our study addressed these two critiques of quality of life research by designing the study based on a conceptual model and using a well validated instrument (MLHFQ) to measure quality of life.

One strength of this study is its theoretical foundation. Previous work on the conceptual framework had shown that QOL was directly and inversely related to fixed and modifiable dimensions of the older adult's disease experience domains (physiological and spiritual/existential) in an oncology population[22]. When this study was designed, HRQOL was conceptualized as an outcome variable explained by similar fixed and modifiable dimensions of the physiological domain in a HF population. The relationship of HRQOL and frailty (measured as a composite of age, number of comorbid conditions, and symptom severity) was theorized a priori to be negatively related based on the literature and this conceptual framework. The findings of the data analyses in this study supported these hypotheses. As frailty increases, HRQOL decreases. While this study was conducted in one end stage disease population – individuals with HF, it is recommended that the index be tested in other populations to broaden its applicability.

A further strength relates to the methodology used in testing the frailty index. Prior to data analysis contamination between the individual items (age, symptoms, comorbidities and the MLHFQ total score) was assessed by a careful examination of multicollinearity and residual statistics. Because both the symptom scale and the MLHFQ contain items related to intensity of symptoms, care was taken to assess for potential collinearity. Only when no significant issue was found did the analysis continue. In addition, the decision to use a second unique sample (Test sample two) to validate the findings from the first test sample (Test sample one) strengthens the evidence supporting the findings of this study. The diversity of the samples in which the index was tested and then validated suggests additional strength and applicability of this index. While there were significant differences between the benchmark sample and the two test samples in relation to functional status (NYHA class), socioeconomic status (income and education), and ethnicity the frailty index continued to explain significant amounts of HRQOL. Furthermore, there were differences between the two test samples. In Test sample one, health perception's beta coefficient (0.20) shows its relative importance in relation to the other predictors in that regression equation, while in Test sample two, income (-0.28) has the largest beta coefficient. This suggests that this index could be used in diverse populations. It is recommended that further testing take place.

There are several limitations to the current study. As a secondary data analysis, the variables available in the data set may not have been the strongest indicators of frailty. The phenotype developed by Fried and colleagues [4] involved objective biometric measurements – weight loss, grip strength, 15 feet walking time as well as the subjective measures of self-report exhaustion and kilocalories expended. For our study all of the variables in the frailty index were self-reported. It is recommended that a future, prospective longitudinal study measure the phenotypic criteria of frailty in current use – unintentional weight loss greater than 10 pounds, weakened grip strength, slowed pace of walking, subjective fatigue, and decreased physical activity [4] – and compare the relationship of those indicators for frailty with HRQOL to explore which measure is more pragmatic and predictive.

The question has been raised as to whether quality of life is better measured as an independent or dependent variable[44]. What is the temporal relationship between frailty and HRQOL? Does frailty predict HRQOL or HRQOL predict frailty? While age and number of comorbid conditions are fixed dimensions of the patient's experience, do the patient's perceptions of whether their life has quality shape their experience of physical limitations? These questions cannot be answered with the cross sectional data in this study. Future studies involving longitudinal measurement should explore the causal relationship between frailty and HRQOL.

A further limitation relates to the instrument used to measure HRQOL. The Minnesota Living with Heart Failure Questionnaire is a commonly used measure in this population[48]. However, questions have been raised as to its sensitivities to subtle differences and psychometric soundness [45, 46]. A broader measure of quality of life, measuring not only health related quality of life, but inclusive of existential and cultural domains might provide a deeper understanding of the true impact of frailty on day to day quality of life for the older adult with HF. Finally, secondary analysis suffers from any limitations that may have existed in the original study. Concerns related to the validity and reliability of the measurement in the parent study, whether concerning instrumentation or language, may call into question any findings in the secondary analysis. However, in this analysis, the original studies were conducted by experienced and respected researchers and were published in peer-reviewed journals.

Conclusion

Heart failure is an increasingly prevalent syndrome in the frail older adult population[49]. Independently, both HF and frailty have been shown to increase the risk of repeat, unplanned hospitalizations, increased health care costs, and death. This study has shown that frailty negatively impacts HRQOL for the older adult with HF. As frailty increases, the negative influences on HRQOL increase and people report lower HRQOL. As treatment preferences can be influenced by perceived HRQOL, it is important for cardiovascular nurses to assess for frailty. This frailty index score provides a means for the clinician to assess for frailty at the point of care. In an older person with multiple comorbid conditions, as well as HF, reports of dyspnea, fatigue, and pain should be addressed by nurses with evidence based symptom palliation. Recent recommendations are available and should be integrated in to current best practice standards[47]. The findings of this study also support the need for future research into the impact with frailty on

HRQOL to determine whether interventions aimed at addressing the modifiable dimensions of the HF patient's lived experience will improve heath related quality of life.

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Table 1.

Demographic Characteristics

	Benchmark sample n= 130		*Test sample one* n= 97		*Test sample two* n= 75		*Difference between Benchmark and Sample groups*
	Percent	Mean (SD)	Percent	Mean (SD)	Percent	Mean (SD)	*p*
Age		70 (13.1) Range 39-95		74 (10.9) Range 24-91		71 (11.7) Range 20-95	
Gender							
Male	54%		47%		43%		
Female	46%		53%		57%		
Marital status							
Married	45%		51%		50%		
Widowed	30%		37%		29%		
Single	8%		3%		7%		
Divorced/separated	17%		9%		14%		
Ethnicity							0.000
Caucasian	73%		98%		98%		
Hispanic	27%		2%		2%		
Education							0.000
Less than 7th grade	28%		2%		1%		
Grade school	6%		9%		11%		
High school	32%		49%		51%		
Business school	7%		5%		5%		
2 year college	16%		16%		13%		
4 year college	6%		11%		14%		
Graduate school	5%		8%		5%		
Work							
Homemaker	8%		8%		11%		
Fulltime	7%		2%		5%		
Part time	5%		5%		9%		
Disabled or retired for health reasons	25%		28%		30%		
Retired for non-health reasons	45%		52%		40%		
Unemployed	10%		5%		5%		
Income							0.002
Less than 10,000	34%		13%		22%		
10,000-14.999	26%		18%		22%		
15,000-19,999	11%		25%		16%		
20,000-29,999	7%		22%		17%		
30,000-44,999	8%		14%		11%		
45,000 or more	14%		8%		12%		
NYHA							0.000
II	2%		13%		8%		
III	36%		56%		48%		
IV	62%		31%		44%		

Table 2.

Mean and Standard Deviations for the Frailty Index Score by Sample

Sample	Mean (SD)	N
Benchmark sample	50.98 (13.96)	130
Test sample one	39.40 (12.29)	97
Test sample two	42.32 (12.14)	75

Table 3.

Proportion of Variance and Multicollinearity Analysis

Correlations with MLHFQ [a] total	Zero-order[b]	Partial[c]	Semi-partial[d]	Tolerance	Variance Inflation Factor
Benchmark Sample					
Age	-0.39	-0.38	-0.33	0.99	1.01
Symptoms	0.48	0.47	0.42	0.96	1.04
Comorbidity	0.21	0.13	0.10	0.97	1.04
Test sample one					
Frailty Index	0.42	0.37	0.35	0.91	1.10
Test sample two					
Frailty Index	0.55	0.55	0.50	0.88	1.13

[a] Minnesota Living with Heart Failure Questionnaire; [b] *zero-order correlation – raw correlation;* [c] *partial correlation –correlation of the given variable with MLHF total controlling for other independent variables;* [d] *semi-partial correlation – correlation of the given variable with MLHF total controlling only for the effect of the other independent variables on the given variable*

Table 4.

Regression Analyses of Predictors of HRQOL and Frailty Index

	Variable	(mean, SD)	Standardized β	*t*	R^2	*F change*	*p*
Test sample one	Gender		0.02	0.14	0.11	1.73	0.14
	Income		-0.11	-0.94			
	Ethnicity		-0.04	-0.36			
	NYHA [a]		*0.09*	0.86			
	Health Perception		-0.20	-1.83			
	Frailty Index	(39.4, 12.3)	0.37	3.32	0.24	11.03	0.001
	MLHFQ[b]	(49.6, 23.8)					
Test sample two	Gender		-0.07	-0.70	0.15	2.45	0.04
	Income		-0.28	-2.74			
	Ethnicity		-0.13	-1.26			
	NYHA[a]		-0.07	-0.74			
	Health Perception		0.03	0.30			
	Frailty Index	(42.3, 13.1)	0.54	5.37	0.40	28.82	0.000
	MLHFQ[b]	(53.7, 24.8)					

[a] New York Heart Association, [b] Minnesota Living with Heart Failure Questionnaire